Fiber-Based Electro-Optic Field-Mapping System

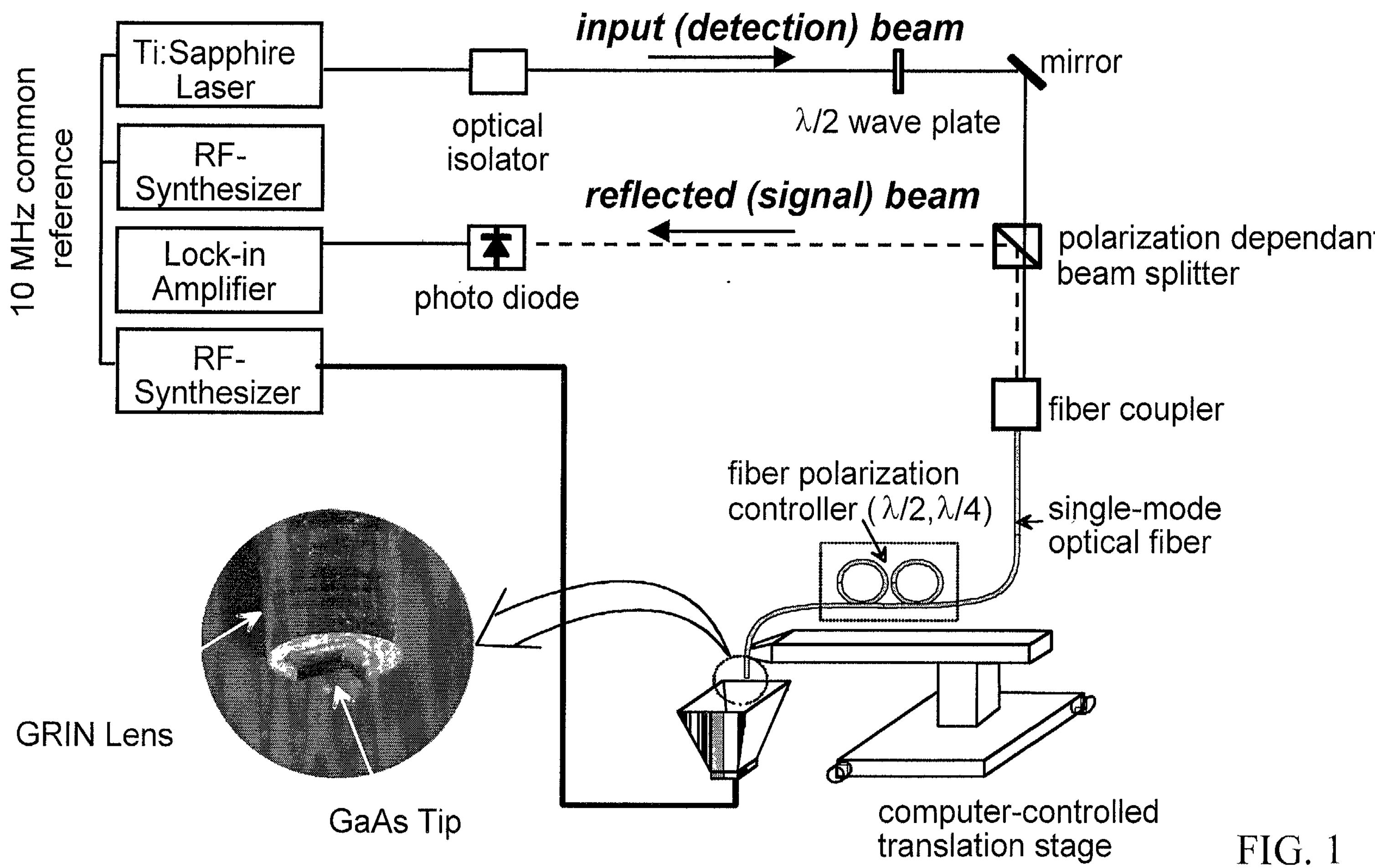


FIG. 1

20900" /5126001

Fiber-Based Electro-Optic Field-Mapping System Polarization Control

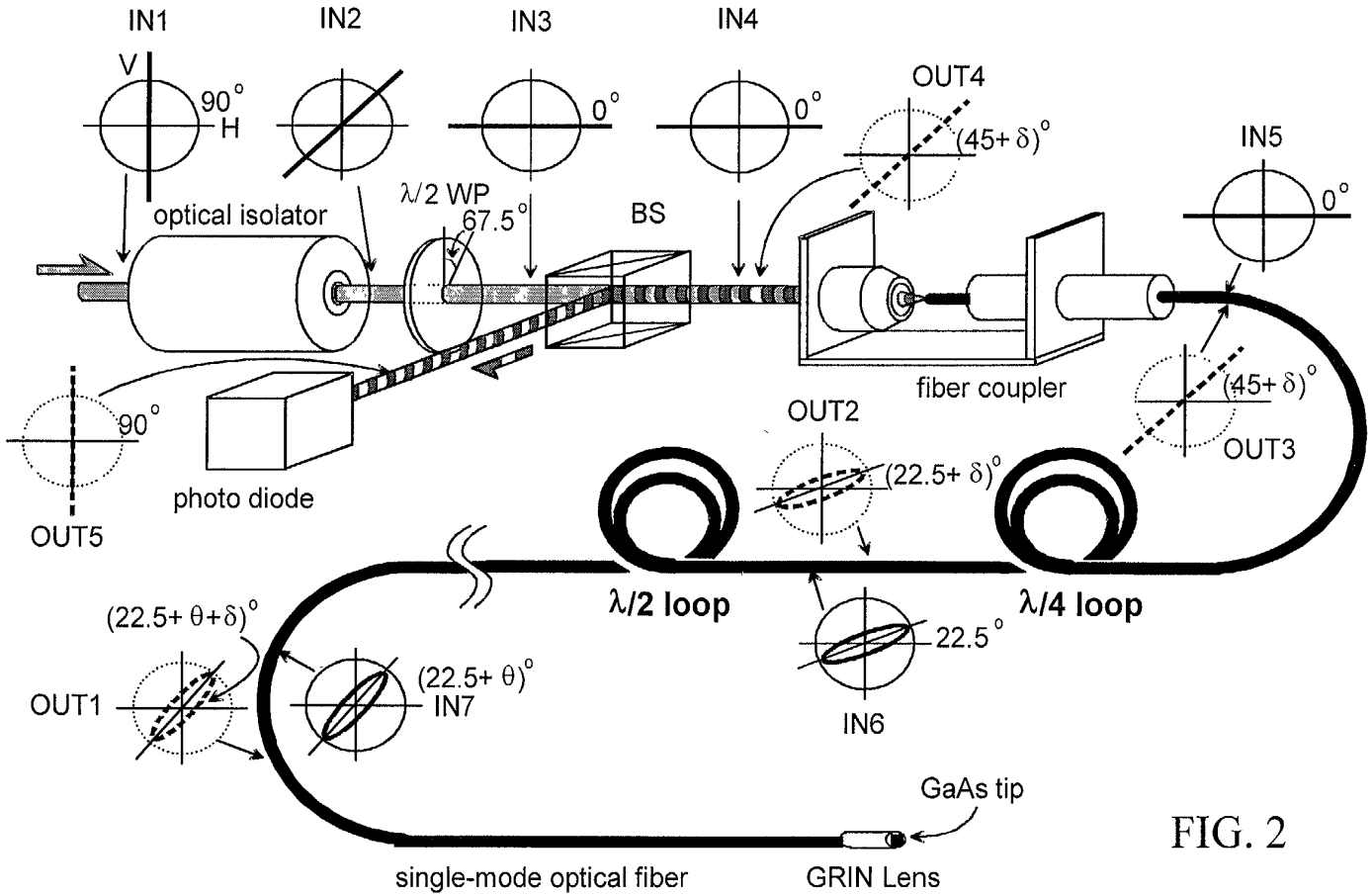


FIG. 2

V H detection (input) beam polarization (w.r.t. horizontal axis)

V H signal (reflected) beam (w.r.t. horizontal axis)

Fiber-Based Electro-Optic Sampling System
GRIN Lens

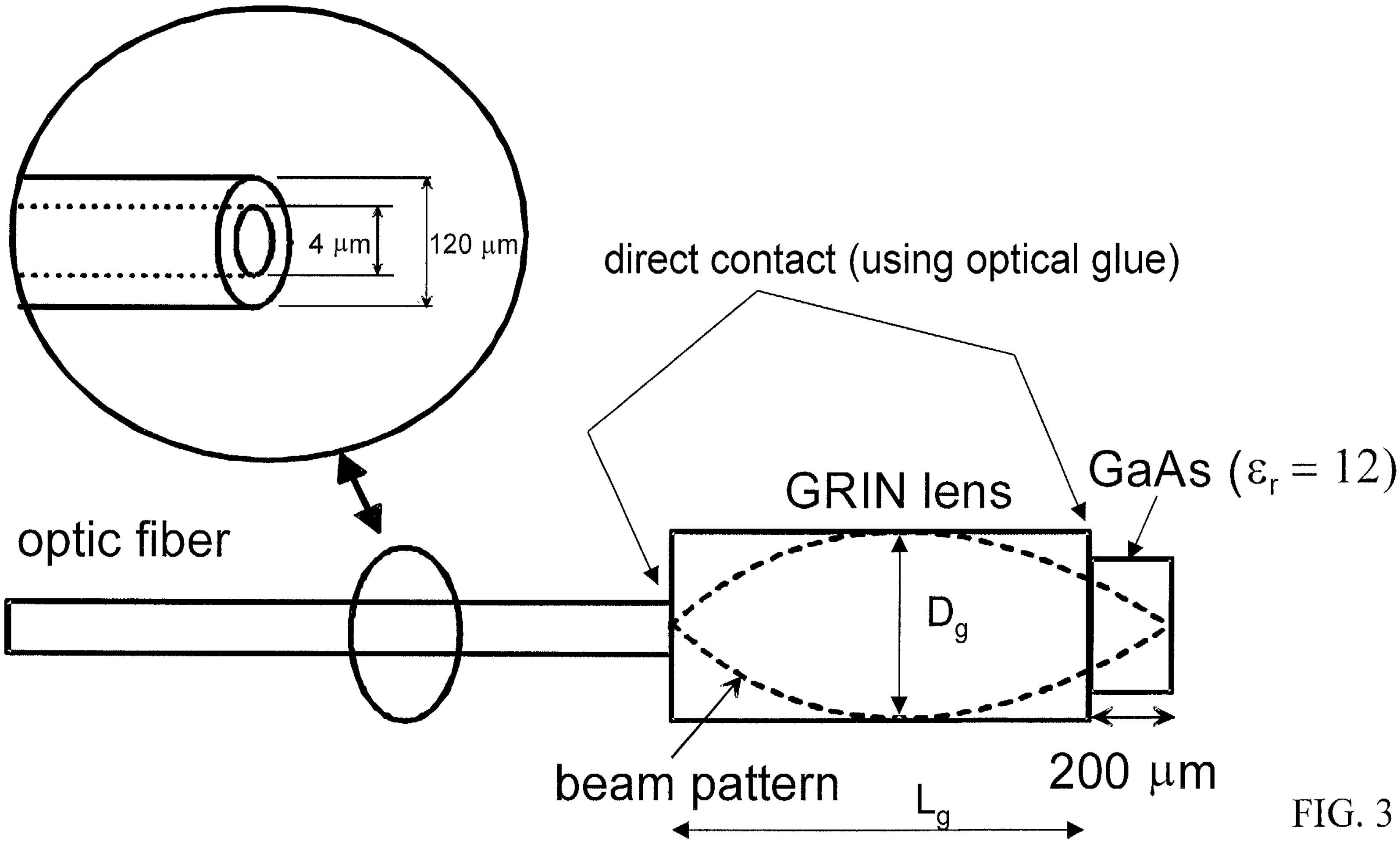
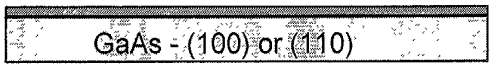


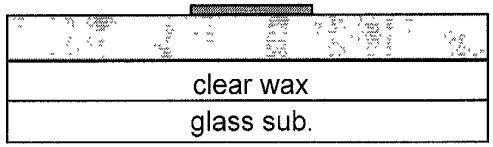
FIG. 3

Fiber-Based Electro-Optic Sampling System
Probe Tip Fabrication Procedure

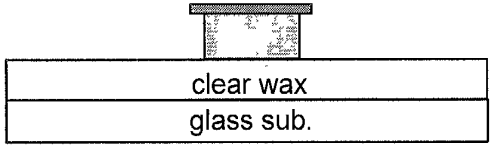


PR 1827 : 3.5 Krpm (30 sec), 105 C° (1 min)

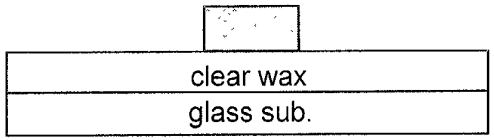
PR 1827 : expose (15 sec), develope (50 sec),
hard bake (105 C°, 1 min)



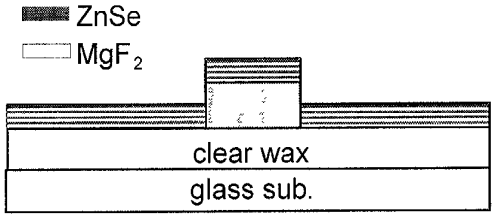
mount sample on glass substrate
using clear wax (on the 150 C° hot plate)



wet etching : $H_2SO_4 : H_2O_2 : H_2O$
= 1 : 8 : 1
+ few drops of NH_4OH
agitate 30 sec every 30 sec
change etchant every 10 min.

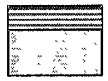


expose without mask (15 sec), develope (90 sec)



Distributed Bragg Reflector (DBR) deposition

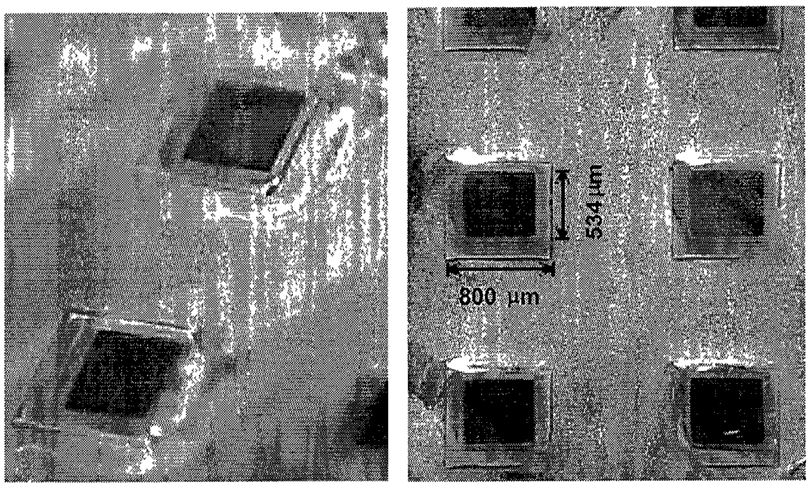
MgF_2 = 1,403 A°, ZnSe = 833 A° x 4 sets



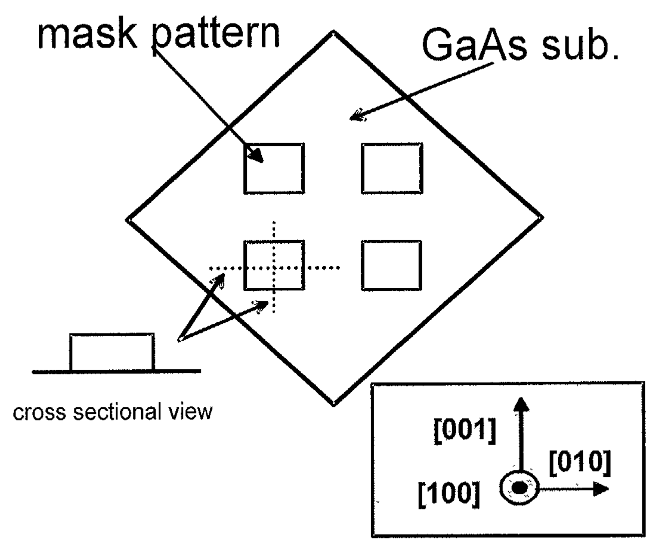
Final probe tip
(released in the hot aceton)

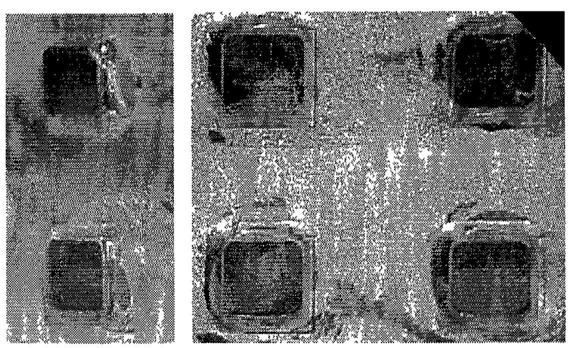
FIG. 4

Fiber-Based Electro-Optic Sampling System Probe Tip Fabrication - (100) GaAs



etching depth ~ 160 µm (7.95 µm/min x 20 min)
(lateral : 130~150 µm, 6.5~7.5 µm/min)





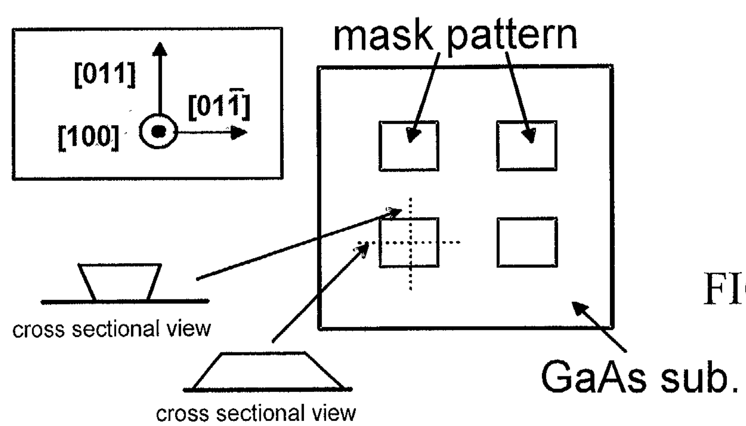


FIG. 5

20902a "ZSTZ600T

Fiber-Based Electro-Optic Sampling System
Probe Tip Fabrication - (110) GaAs

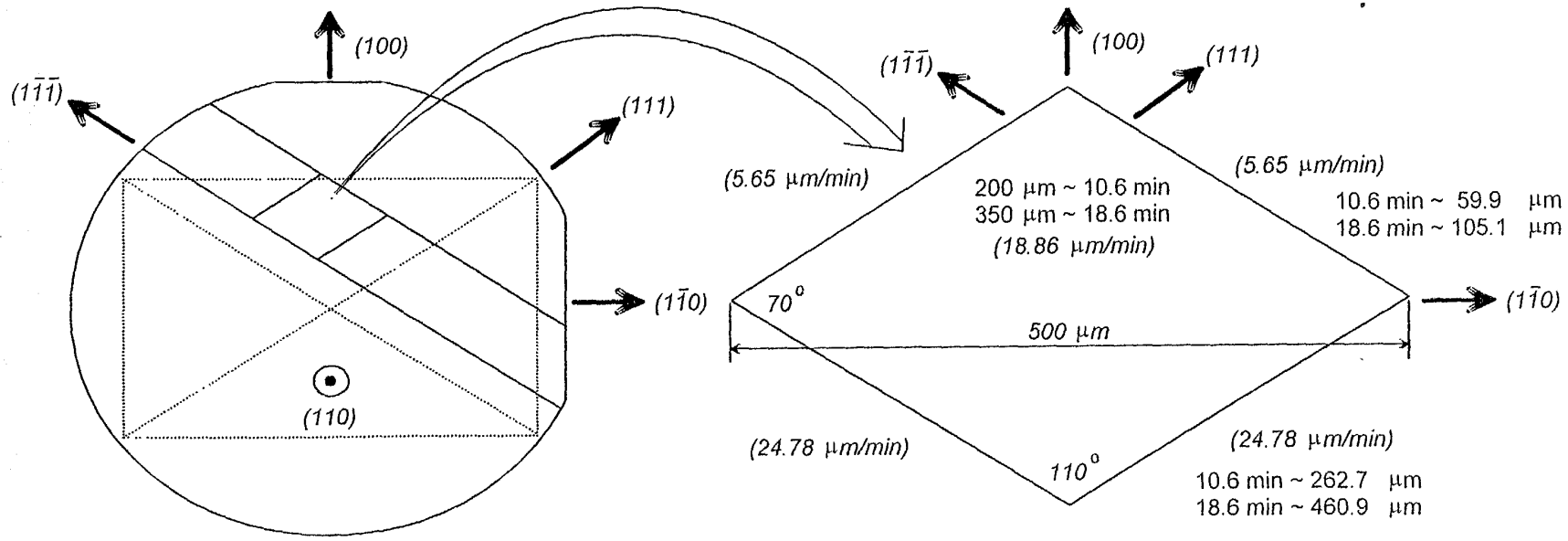
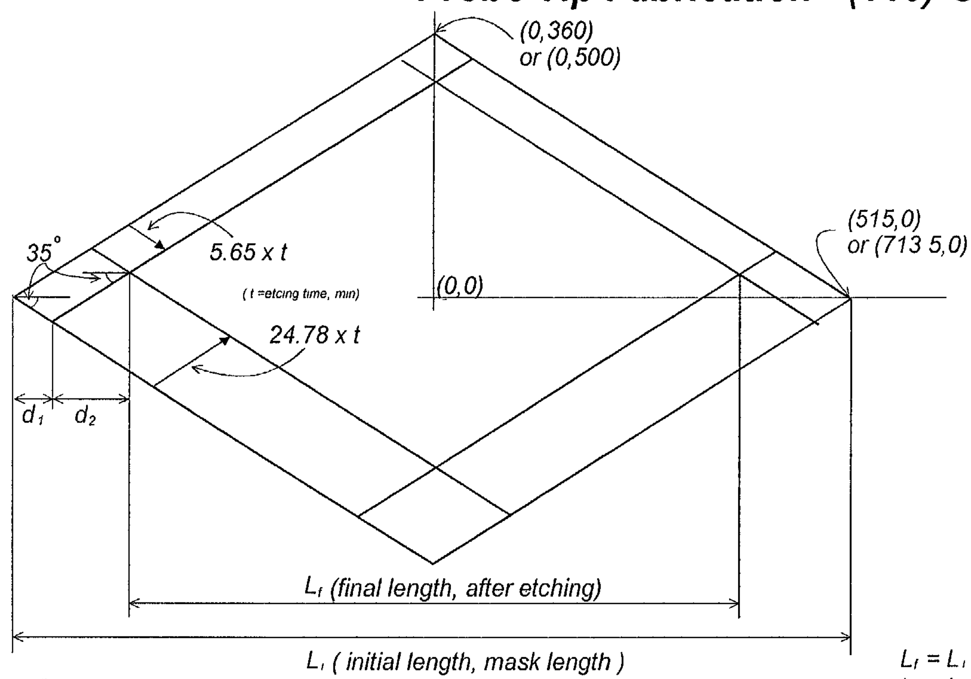


FIG. 6

Fiber-Based Electro-Optic Sampling System
Probe Tip Fabrication - (110) GaAs



goal : L_f = 500 μm

$L_f = L_i - (d_1 + d_2) \times 2$

$L_f = L_i - [\,5.65 \times t \times \cos(35^\circ) + 24.78 \times t \times \sin(55^\circ)\,] \times 2 = 500$

$L_i = 500 + [\,5.65 \times \cos(35^\circ) + 24.78 \times \sin(55^\circ)\,] \times 2 \times t$

where,

t = 200 / 18.86 (μm/min) = 10.6 min for 200 μm wafer

t = 350 / 18.86 (μm/min) = 18.6 min for 350 μm wafer

(t = etching time, min)

► L_i = 1029 μm for 200 μm wafer,
= 1427 μm for 350 μm wafer

FIG. 7

Fiber-Based Electro-Optic Sampling System
Probe Head Assembly

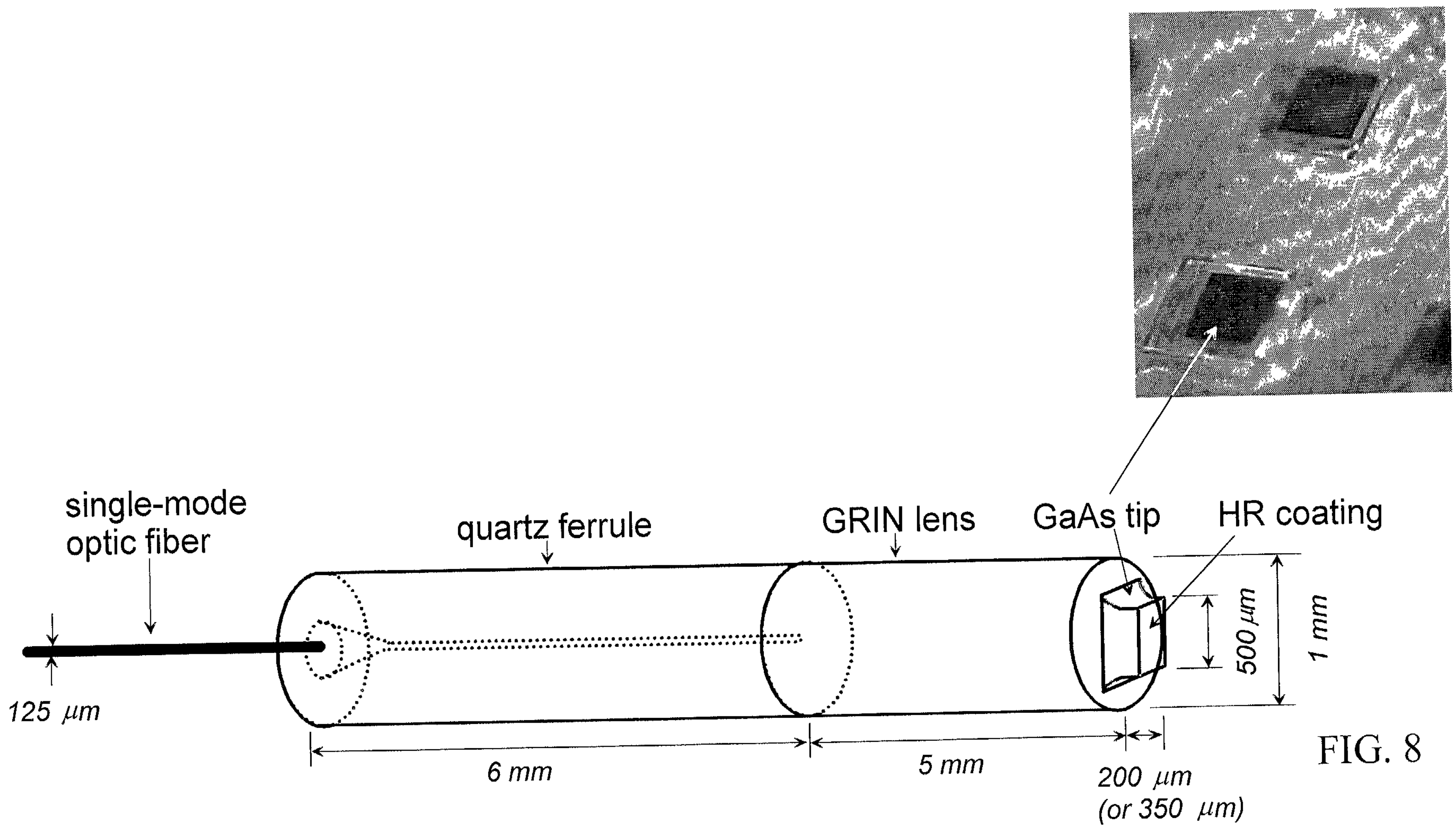


FIG. 8

20080° /5126001

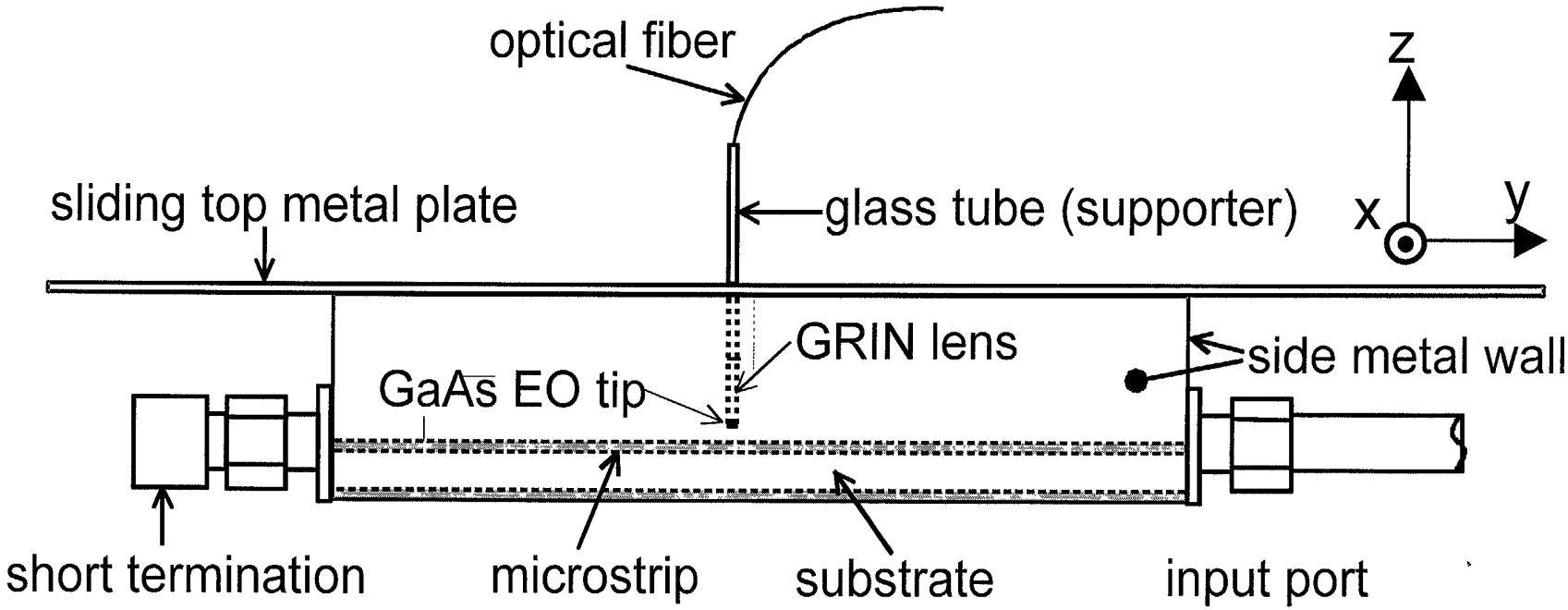


FIG. 9

Patent Application Publication

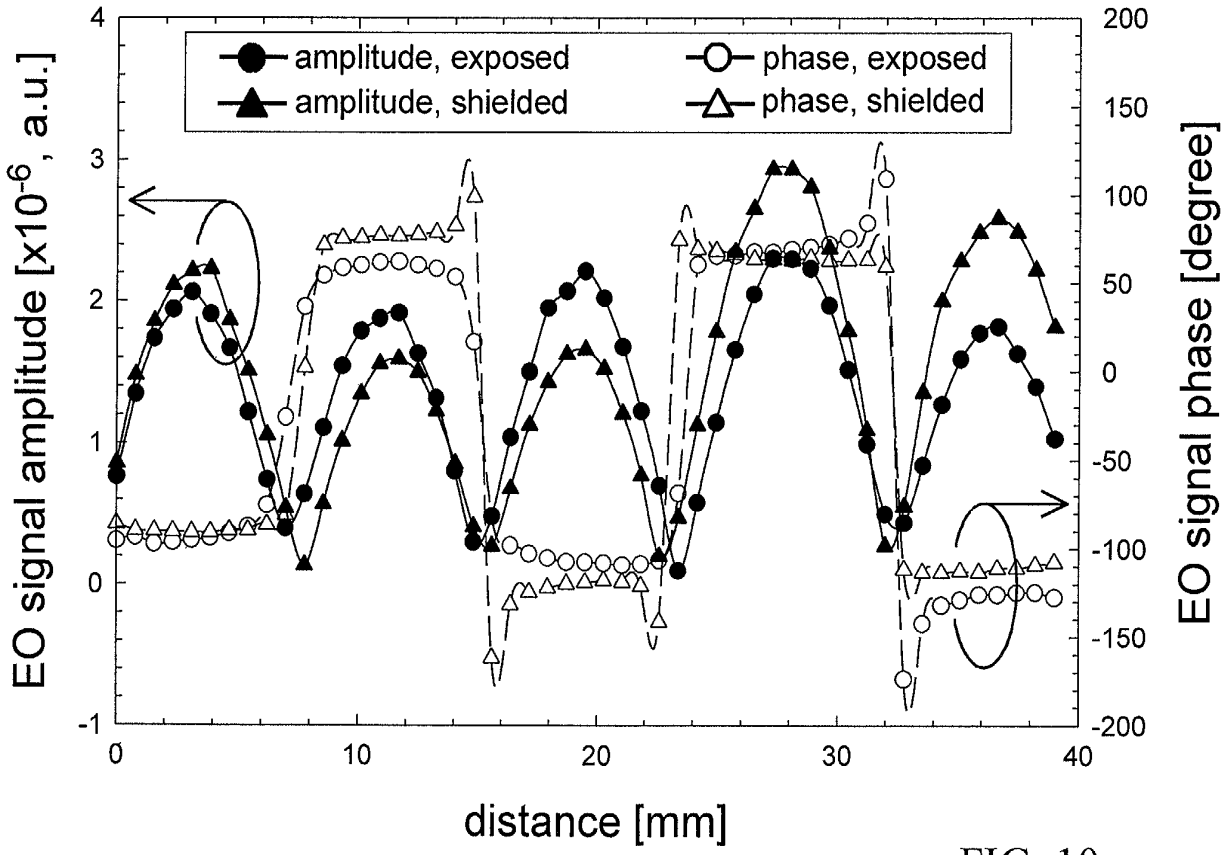


FIG. 10

20908A "ZSTZ600T

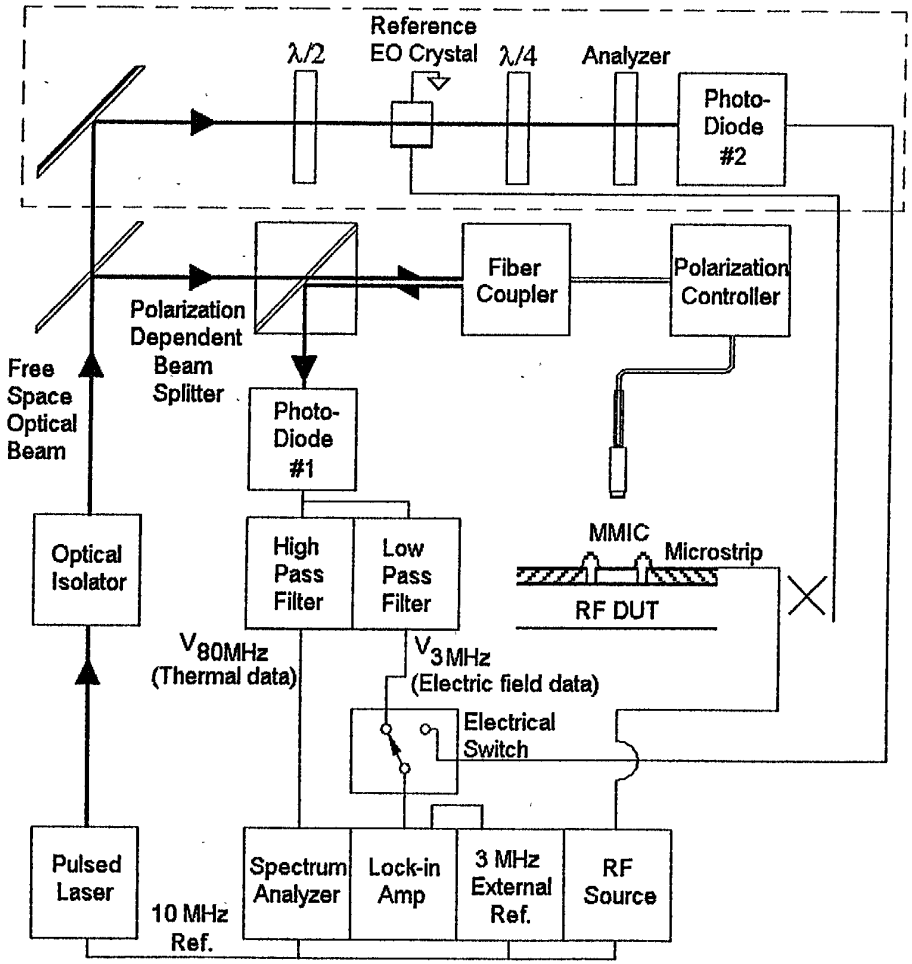


Fig 11

EDGEWOOD CHEMICAL

Fig 12

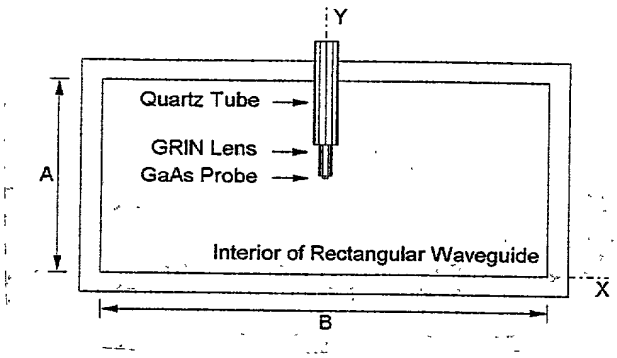

Y
Quartz Tube
GRIN Lens
GaAs Probe
A
Interior of Rectangular Waveguide
X
B

FIG 13

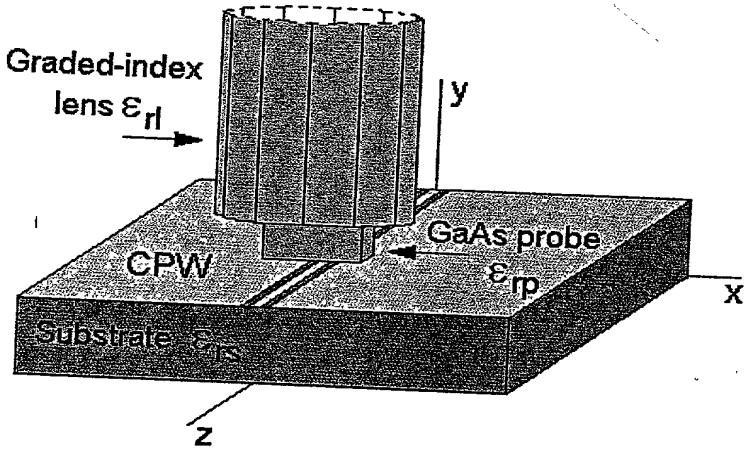
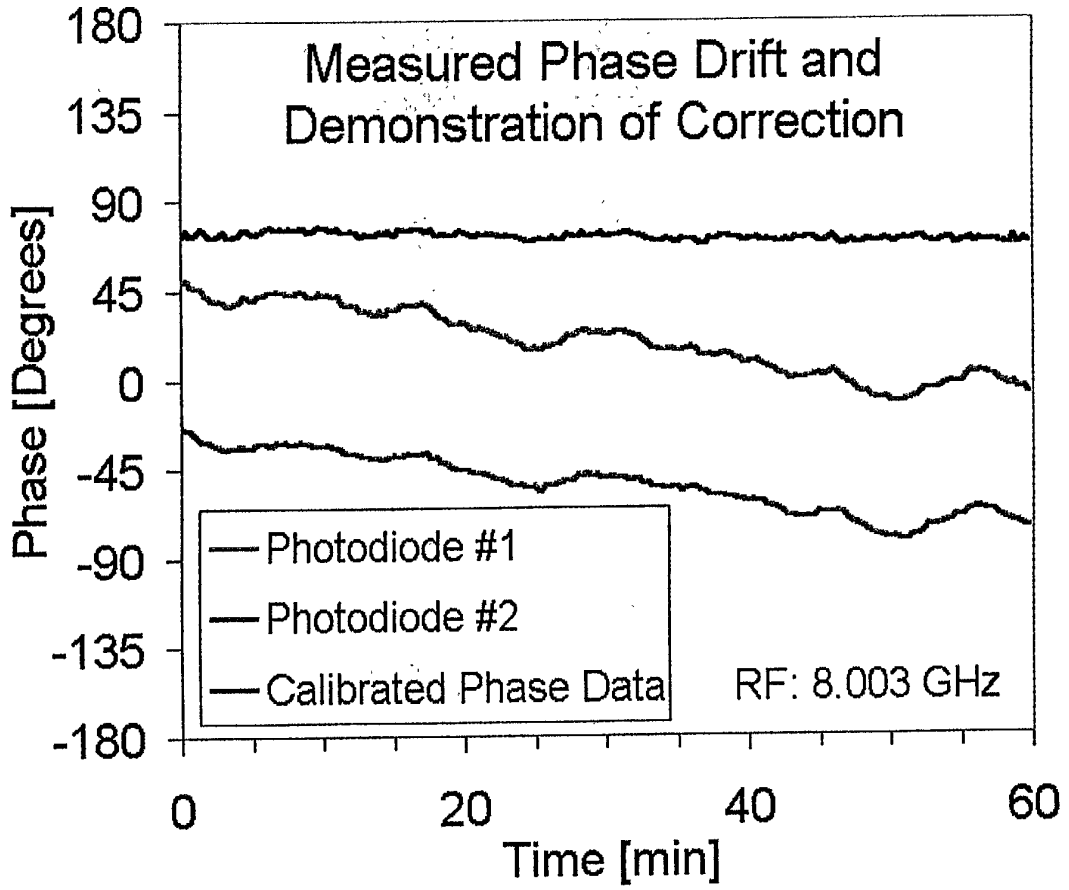

Graded-index
lens ε_{rl}
y
GaAs probe
ε_{rp}
CPW
X
Substrate ε_{rs}
z

FIG 14

Characterization - Electric Field Phase



- Over one hour, measured temporal phase stability is ±3°.

Fig 15

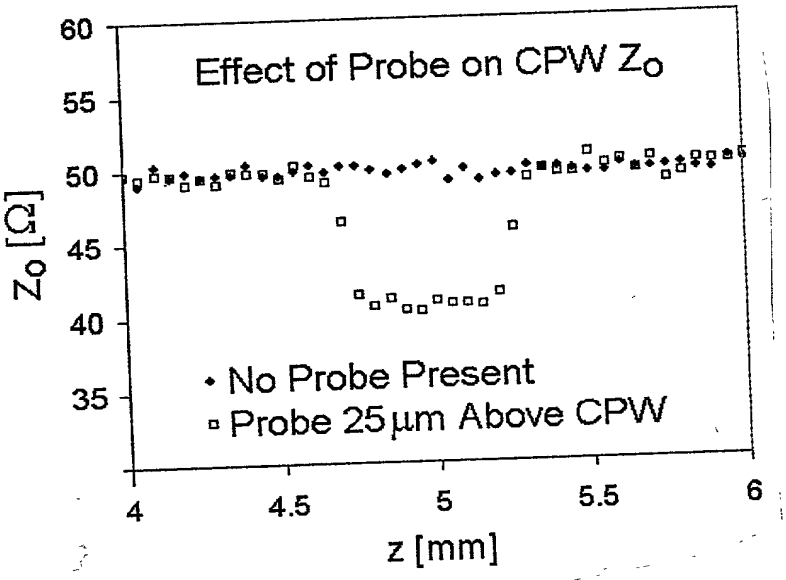
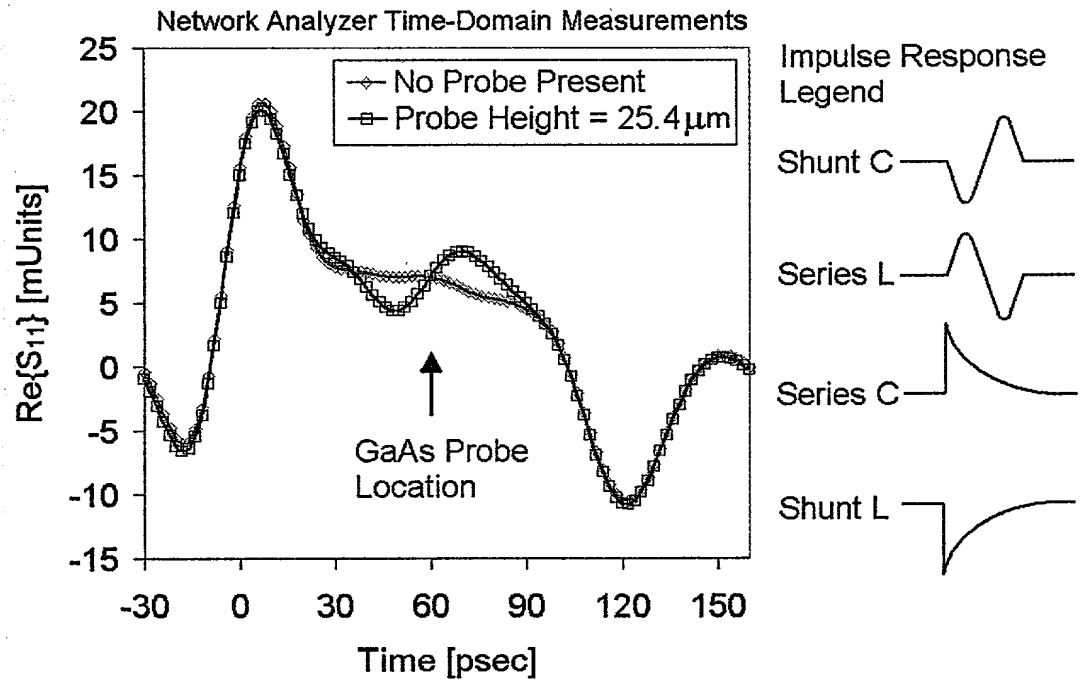
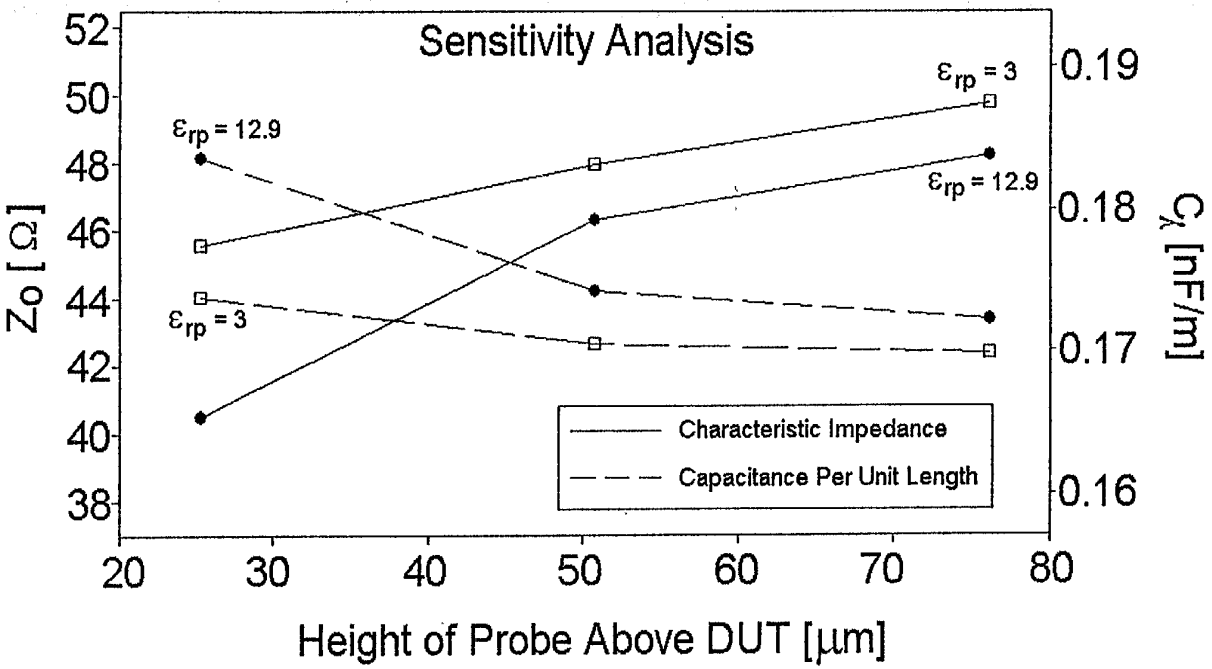


FIG 16



•Frequency domain measurements (2 - 40 GHz):
|S11| < -30 dB with and without probe.

FIG 17



•Effect of probe is equivalent to a lumped shunt capacitance on the order of femtofarads.

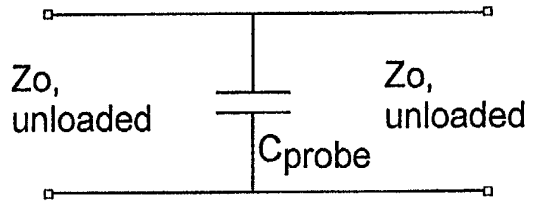


FIG 18

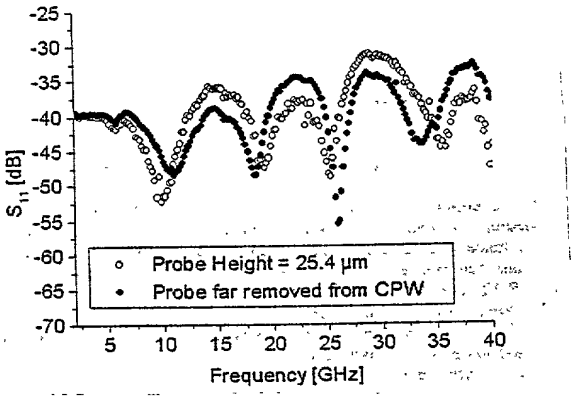

-25
-30
-35
-40
-45
-50
-55
-60
-65
-70
S_{11} [dB]
5
10
15
20
25
30
35
40
Frequency [GHz]
Probe Height = 25.4 µm
Probe far removed from CPW

FIG 19

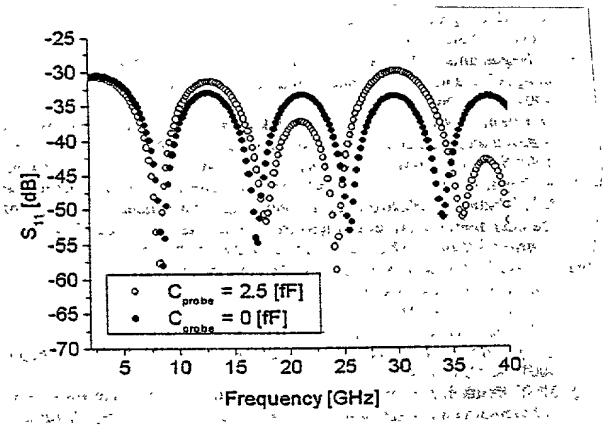

-25
-30
-35
-40
-45
-50
-55
-60
-65
-70
S_{11} [dB]
5
10
15
20
25
30
35
40
Frequency [GHz]
C_{probe} = 2.5 [fF]
C_{probe} = 0 [fF]

FIG 20

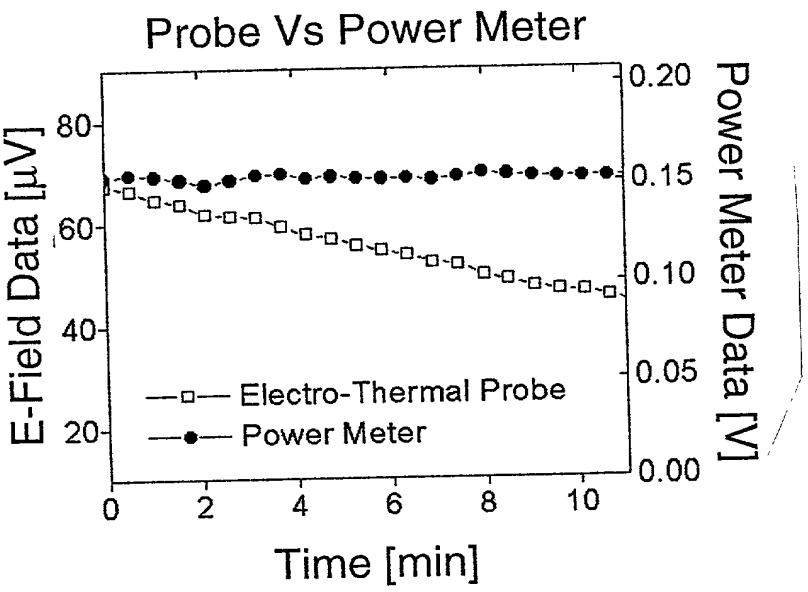

Probe Vs Power Meter
E-Field Data [µV]
Power Meter Data [V]
Time [min]
Electro-Thermal Probe
Power Meter
80
60
40
20
0.20
0.15
0.10
0.05
0.00
0
2
4
6
8
10

FIG 21

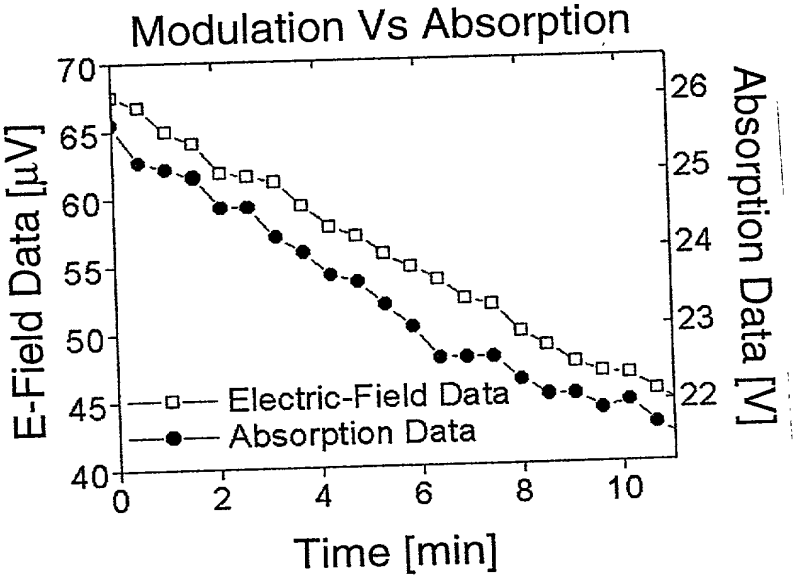

Modulation Vs Absorption
E-Field Data [µV]
Absorption Data [V]
Time [min]
Electric-Field Data
Absorption Data
70
65
60
55
50
45
40
26
25
24
23
22
0
2
4
6
8
10

FIG 22

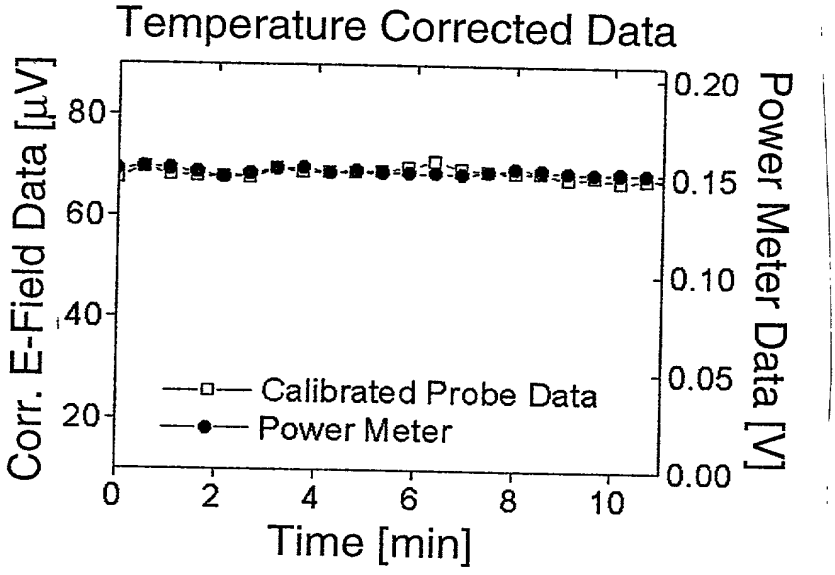

Temperature Corrected Data
Corr. E-Field Data [µV]
Power Meter Data [V]
Time [min]
Calibrated Probe Data
Power Meter
80
60
40
20
0.20
0.15
0.10
0.05
0.00
0
2
4
6
8
10

FIG 23

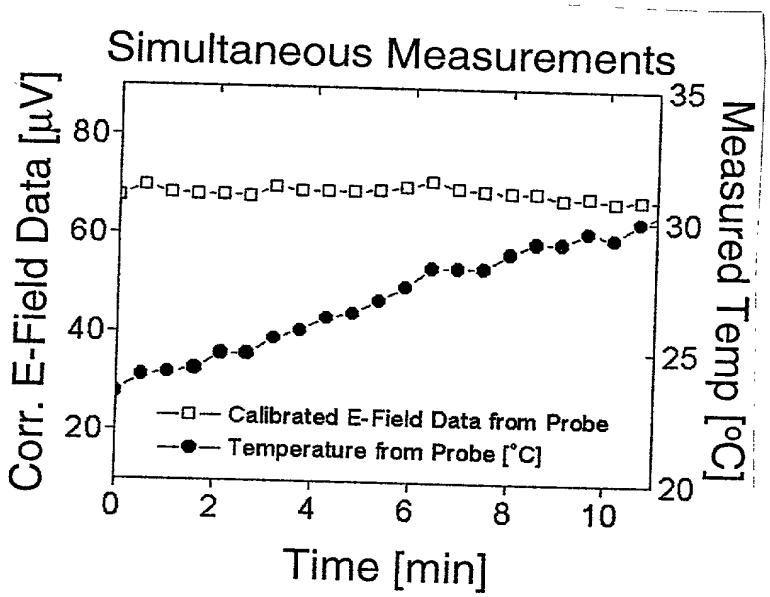

Simultaneous Measurements
Corr. E-Field Data [µV]
Measured Temp [°C]
Time [min]
Calibrated E-Field Data from Probe
Temperature from Probe [°C]
80
60
40
20
35
30
25
20
0
2
4
6
8
10

FIG 24